THE SCOTTISH HORTICULTURAL RESEARCH INSTITUTE

FIRST ANNUAL REPORT 1953-1954

MYLNEFIELD, INVERGOWRIE, DUNDEE
Tel.: INVERGOWRIE 441

WEST OF SCOTLAND UNIT
Auchincruive, Ayr
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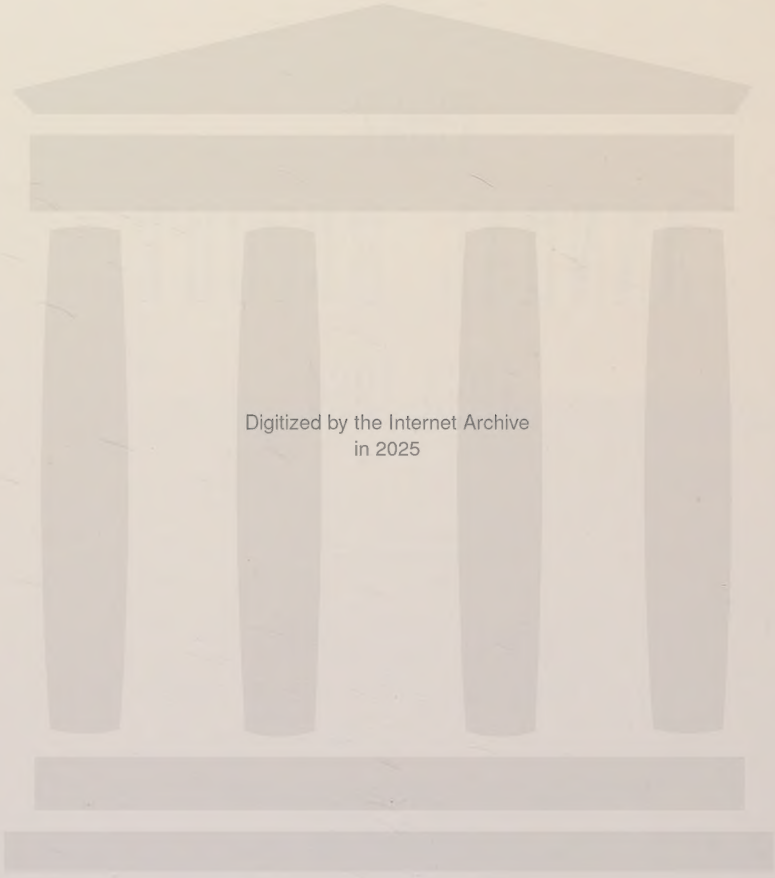

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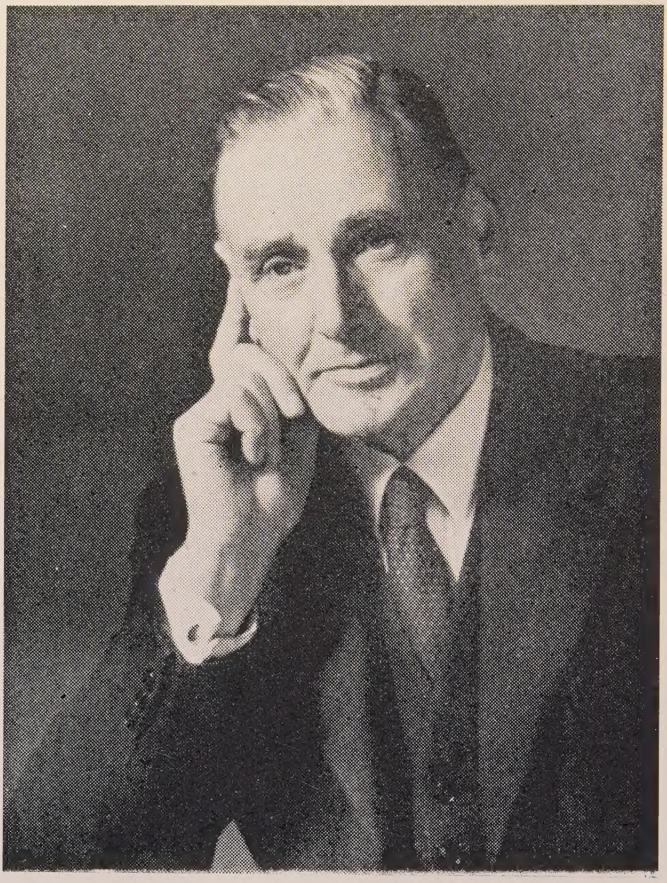

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The Origin and Establishment of the Scottish Horticultural Research Institute

by T. Swarbrick

On April 1st, 1953 the Scottish Horticultural Research Institute became legally established as a self-governing, grant-aided research organisation. This short historical survey of its origin and development has been prepared at the request of the Governing Body.

Although in the past two centuries there have been periods of acute neglect of the land and its interests, there have also been periods of outstanding development. In Scotland, in particular, there was a general revival of interest in agriculture following the '45 rising, when the activities of the "improving landlords" brought large areas of land into a better state of cultivation and produced agricultural writers of considerable note, of whom Lord Kames is probably the best known. Soon afterwards Sir John Sinclair became eminent in this field. He it was who inspired the preparation of the First and Second Statistical Accounts of the state of agriculture in Scotland, from which we are now able to reconstruct the conditions of those times. Sir John also took a leading part in the founding, in 1793, of the Board of Agriculture. It was during this same latter part of the eighteenth century that the foundations of the now famous Horticultural Societies of England and Scotland were being laid.

This renewed interest on the part of landowners and others stimulated many people to undertake what we nowadays called "research." Whilst this was mainly of a practical nature, directed towards improvements in livestock, methods of cultivation, crop varieties and the like, notable advances were made also in the basic sciences. Much of this work was inspired by the "learned societies." Early records of the Royal Caledonian Horticultural Society, for example, show that membership was not confined to working horticulturists; many men eminent in the medical and other professions took a leading part in this society's discussions and deliberations. A certain Dr. Duncan is quoted as saying; "It has been observed by an ancient writer of the first eminence that life is short, art long, opportunity fleeting, experiment precarious and judgment difficult." These observations, made so long ago, can scarcely be improved upon to-day.

From those times to the problems of the present century is a far cry. Of the harsh years of depression that bedevilled the period between the two wars little need be said here, except that they brought great economic disasters to the horticultural industry in Scotland, as elsewhere; but from our present point of view they also revealed clearly certain serious weaknesses in the organisation of Scottish horticultural education and the provision of advisory services, whilst many felt that the almost complete lack of horticultural research facilities was a still greater hindrance to the expansion of the industry. During this period Mr Storrie, one of the present governors of the Institute, raised with the then Secretary of State for Scotland the question of establishing a Scottish Fruit Research Station. The outcome of this correspondence, conducted through the good offices of the late Mr MacGregor Mitchell, K.C., M.P., was an assurance by the Secretary of

State in May, 1924, that demonstrational and experimental centres were to be established in connection with the Scottish Agricultural Colleges, for the purpose of providing fruitgrowers with information on their various problems. This aroused interest in many other quarters and eventually resulted in the foundation, in October, 1927, of the Scottish Horticultural Advisory Committee, under the chairmanship of Mr W. Cuthbertson, J.P., V.M.H. Its main function was to advise and assist the Department of Agriculture for Scotland on all matters concerning horticulture, and the minutes of this committee show that, from its very inception, frequent reference was made to the need for research. Representing, as it did, all aspects of the horticultural industry, this committee soon proved an indispensable means of liaison between government administration and the industry. Following Mr Cuthbertson's death in 1933 its Chairmanship passed to Mr R. L. Scarlett, also to-day one of the governors of the Institute.

Co-incident with the depression of 1920-30, the horticultural industry of Scotland suffered an alarming incidence of pests and diseases more or less new to soft fruit crops. In 1921, strawberry growers in Lanarkshire noticed a rather rapid decline in the vigour and yield of their plantations, and by 1922-23 it was clear that disaster, due to a hitherto unknown malady, was imminent. Action was taken by the Department of Agriculture for Scotland, the West of Scotland Agricultural College and the growers themserves, and it is to the credit of the late Mr Dudley V. Howells, of the West of Scotland Agricultural College, and of Mrs Alcock and Dr. Foister of the Department of Agriculture's Plant Pathology Service, that the cause of the malady was quickly discovered. Much controversy raged at the time, and reputable authorities considered that the trouble was due almost entirely to bad drainage. But the finding of Howells, Alcock and Foister, published in 1930, became fully substantiated; strawberry red-core root rot, as it was named, was caused by a soil-borne fungus, a new species of *Phytophthora*. This fungus was later studied by Dr. C. J. Hickman in England and named by him *P. fragariae*.

The discovery that red-core was caused by a fungus that spread most rapidly in wet ill-drained soils naturally led to attempted control of the disease by means of fungicides and soil sterilisants. Assessment of the value of these was Mr R. D. Reid's first task on his appointment, in 1930, as assistant to Mrs Alcock and Mr Howells. He soon found such control measures impracticable, and the bold decision was made to attempt the breeding of strawberries resistant to the red-core disease. This approach seemed much less sensible at the time than it does now and, in undertaking this task, Mr Reid had many difficulties to surmount. The subsequent discovery of genetical sources of resistance enabled Mr Howells to report to the Horticultural Advisory Committee in 1934 that a number of resistant seedlings had been produced;—news that was received with acclamation. In the autumn of 1937 five of the new "Auchincruive" seedlings were distributed in small quantities to local growers, and it was soon evident that these seedlings would grow and crop on land where susceptible varieties had died out within a year to eighteen months from planting. Although not ideal commercial varieties, the red-core resistant seedlings were obviously of value to Lanarkshire growers and some 300,000 plants were distributed in 1941. Mr Howells died in 1940, before this first large scale distribution had been made, but at least he had been able to see that ultimate success was assured.

In the early years growers contributed both individually and collectively, despite the fact that they themselves were victims of the prevailing trade depression. The Scottish Fruitgrowers Research Association, formed at Carluke in October, 1943, undertook, among other activites, the organisation of financial support for the work at Auchincruive. It is to the credit of all concerned that sufficient funds were found to keep the work going during these difficult years.

In 1947, fifteen years after the breeding work began, the seedling named "Auchincruive Climax" was introduced. This variety has been one of the outstanding contributions of horticultural research to the industry in the past fifty years. It is now the variety most widely grown in Great Britain, and is rapidly acquiring a high reputation abroad wherever strawberries are grown under climatic conditions similar to those of Great Britain. Thus, the work initiated by Howells, Alcock and Foister, and carried on so successfully by Reid, proved the value of patient investigation and enabled growers and Government alike confidently to support increased activity in horticultural research.

Raspberry growing, the most important horticultural industry of Angus and Perthshire, had its problems during this period too; and with these Mr N. H. Grubb and Dr. R. V. Harris, both of the East Malling Research Station, have long been associated. By 1930 the work of these two men had already forecast the danger to be expected from mosaic diseases. By 1940 the variety Lloyd George, for many years the mainstay of Scottish growers, had declined so much in yield and vigour owing to virus infection that it was rapidly being discarded in favour of Norfolk Giant. The discovery, by Mr Grubb in 1941, of a new and lethal disease of Norfolk Giant in Angus thus caused deep concern. During the summer of 1942 this disease was investigated jointly by Dr. R. V. Harris, Mr A. D. Bryce of the East of Scotland College of Agriculture, and Dr. C. E. Foister. The results of this and subsequent work showed that the Norfolk Giant disease, now named leaf curl, was caused by a virus that produced symptoms on Baumforth's Seedling very like those of the so-called "Baumforth's disease" that had ruined plantations of this variety in Scotland during the 1920's.

Largely as a result of these developments, the Agricultural Research Council arranged with Dr. R. G. Hatton, Director of East Malling, that Dr. Harris should spend at least three months each summer in Scotland studying the disease causing the decline in yield and vigour of raspberries. Headquarters for this work were established in the Botany Department and in the grounds of West Park House, University College, Dundee, through the aid of the late Professor R. J. D. Graham, Head of the Botany Department, and Professor Angus Fulton, then Principal of University College. As resident assistant to Dr. Harris in Scotland, Dr. C. H. Cadman was appointed in November, 1943, having been released for this work by the Scottish Society for Research in Plant Breeding. By 1946, the scope of the work had so increased that the need for additional staff was evident. In that year, Dr. C. A. Wood was appointed as Pomologist, to undertake the propagation, selection and trial, under Scottish conditions, of the new raspberry seedlings raised at East Malling by Mr Grubb, and to supervise the now somewhat extensive nurseries of virus tested raspberry stocks. Dr. A. R. Hill was appointed as Entomologist, to investigate the insect pests of raspberries, particularly those responsible for spreading raspberry virus diseases. At East Malling a junior assistant to Dr. Harris was also appointed. This

unit now constituted the Agricultural Research Council's Scottish Raspberry Investigation, administered by East Malling Research Station and directed by Dr. R. V. Harris. In 1946 Professor A. D. Peacock kindly provided additional working room for the unit in the Zoology Department, University College.

Analysis of the causes of raspberry decline proceeded hand in hand with efforts to produce healthy raspberry stocks and, in particular, with a search for virus free stocks of Lloyd George. Following a visit to New Zealand in 1944 by Mr Giles Tuker, who returned impressed with the vigour of Lloyd George plantations there, Dr. Harris arranged with the Nelson Raspberry Marketing Committee and the New Zealand Department of Scientific and Industrial Research for the importation of some canes. The discovery at Dundee, in 1946, that these were virus free by the then current standards, led eventually to the re-introduction to commerce of healthy stocks of Lloyd George. It is no exaggeration to say that, by 1951, through the development of healthy stocks of existing varieties and the introduction of new ones of high yielding capacity, the Scottish raspberry industry had been revived and a new period of expansion and prosperity initiated.

Both the raspberry and the strawberry investigations were initiated in response to emergencies created by outbreaks of new and devastating diseases. Both had made real contributions to commercial practice and demonstrated the value of locating research in the midst of the local or regional problems with which it was intended to deal.

The next sequence of events for review stemmed from the formation, in 1944, of a Great Britain Committee under the Chairmanship of Professor E. J. (now Sir Edward) Salisbury. Its terms of reference were " To carry out a preliminary survey of the field of horticultural research in respect of fruit and vegetables, with the object of determining how best the research programmes at Institutes, Advisory Centres, Universities or elsewhere can be extended so as to ensure (a) a general advance in the application of basic scientific knowledge to the problems of horticulture, and (b) that the major problems of horticulture are attacked."

The Committee duly discharged its duty and presented its report. As regards Scotland they recognised its special problems and recommended that research centres should be established for (a) Vegetables in the East of Scotland, (b) Glasshouse crops in the West of Scotland, and (c) Fruit crops in the East of Scotland. The report duly came before Parliament, which accepted its recommendations in principle and gave the necessary authority to proceed to their implementation.

Acting upon this authority the Department of Agriculture for Scotland after discussion with the Scottish Horticultural Advisory Committee, set up a " Horticultural Research Committee " consisting of eighteen members representing all aspects of horticulture in Scotland, under the chairmanship of Dr. Caie. They held their first meeting at St. Andrew's House on the 8th October, 1946. The Chairman traced briefly the work leading up to their appointment.

In outlining the methods by which the Horticultural Research Committee could attack its duties, Dr. Caie said he would prefer to see the Committee concentrate on deciding the type of research station or stations

required, the acreage likely to be needed and the staff, accommodation and equipment that would be necessary. Following a very full discussion it was agreed that the number of research stations to be set up in Scotland should be limited to three, viz. :—

1. A Vegetable Station in the East.
2. A Fruit Station in Angus or Perthshire.
3. A combined station for glasshouse crops, flowers and fruits in the South or West.

It was then agreed to appoint three Sub-Committees to consider possible sites and that while an area of 100-200 acres should be regarded as appropriate, larger areas should not be ruled out because of size alone. In order to obtain continuity and unity of purpose Dr. Caie was elected Chairman of all three Sub-Committees.

No suitable sites had been found when the committee met for a second time on July 29, 1947, but at their third meeting, on April 7th 1948, the fruit research sub-committee reported that Mylnefield, Invergowrie, a farm of 165 acres, might become available and that their first impressions of it were favourable. A small sub-committee was appointed to view the farm and empowered to recommend its purchase. This they did, and the news that negotiations for the purchase of Mylnefield were in progress was reported to the Horticultural Research Committee at its fourth meeting on March 29th, 1950. Also at this meeting tributes were paid to Dr. Caie, whose sudden and untimely death earlier that year was keenly felt. In considering plans for the future, the chairman, Mr Senior, said that the Department, after careful consideration of the Committee's views, proposed that the Mylnefield station should be integrated with the glasshouse and vegetable stations, as and when these were established, by appointing one Director and one administrative body to control all three. No suitable sites for either glasshouse or vegetable research had been found, and the Committee agreed that decisions concerning these should be postponed until a Director for the Mylnefield station had been appointed.

Mylnefield was finally acquired in November, 1950, and the first and present Director of Horticultural Research in Scotland, Dr. T. Swarbrick, was appointed and commenced duty on March 1st, 1951. On April 1st of that year the extant staff of the Scottish Raspberry Investigation accepted appointments in the newly created Scottish Horticultural Research Institute. Temporary headquarters for the Institute were found at Vernonholme, Riverside Drive, Dundee, through the good offices of Major-General Wimberley, then Principal of University College, Dundee. For the financial year 1951-52 Dr. Swarbrick assumed direction of the Strawberry Disease Investigation at Auchincruive, although the formal appointment of Mr Reid and his staff to the Institute was deferred until April 1952.

During the last few weeks of the year ending March 31st, 1951, decisions on the siting of the glasshouse and laboratory buildings and on the broad plan of development of the farm had to be made rapidly. In conjunction with the Department's architects and surveyors, all this was achieved. Three aluminium alloy tomato houses were purchased, erected and glazed by March 31st, and a start had been made on the potting-shed buildings. The first experimental plantings of raspberries were made that month.

The co-ordination of the former raspberry and strawberry investigations, the planning of the new Institute's programme, and the preparation of plans for new buildings, both at Mylnefield and Auchincruive, occupied most of the year from April, 1951 to April, 1952. During that period additional staff were found for both centres and the broad lines of the Institute's research programme were approved.

In April, 1952, the Secretary of State for Scotland appointed a Board of Management for the Institute, with Professor J. R. Matthews as chairman. This body met for the first time on May 25th, 1952, at Dundee, when Sir Patrick Laird, Secretary of the Department of Agriculture, thanked the members on behalf of the Secretary of State for accepting office, and wished the new organisation every success. The Board of Management was commissioned to advise the Secretary of State on the administration of the new Institute pending its incorporation as an independent, grant-aided research establishment. Farm and Estate, Finance, and Staff and Research committees were formed, each with its own convener and responsible to the Board. These arrangements provided an opportunity for the members of the Board to become familiar with their respective duties and responsibilities, prior to their anticipated appointment as members of the Governing Body of the Institute. The Board met three times during that year to consider the more immediate and pressing problems arising from the administration and future development of the Institute. The lines of research to be pursued and the staff requirments were agreed upon, and the Director was provided with a working plan of development.

Meanwhile, substantial progress was made at Mylnefield. Severe restrictions on capital developments necessitated a revision of building plans, and this delayed the proposed conversion and enlargement of the farmhouse into the main laboratory and administrative building. Work on this eventually began during the summer of 1952, and completion by the autumn of 1954 was anticipated. A glasshouse laboratory was erected adjoining the two glasshouses allocated to plant pathology work, and the glasshouse heating system was installed. The service building intended for the glasshouse block was largely converted to temporary laboratories, and the cart shed into offices for the Director and the administrative staff. Two graduate assistants and two junior assistants were appointed to the technical staff.

The West of Scotland Unit of the Institute, as it was now named, being more than 100 miles distant from Mylnefield, presented special problems of administration. In order to meet the wishes of the Horticultural Research Committee and the known needs of the industry, it was obvious that the strawberry work should not only continue at Auchincruive but be widened in scope. The West of Scotland Agricultural College had housed the strawberry unit for upwards of 20 years and had generously provided all the main facilities, including six acres of red-core infected land, the latter an absolutely essential requirement for Mr Reid's work. While this arrangement had undoubtedly worked to everyone's complete satisfaction, the merging of the strawberry unit with the Scottish Horticultural Research Institute made some new arrangement with the College essential.

Following negotiations conducted through the Department of Agriculture for Scotland, the West of Scotland Agricultural College generously agreed to lease the land used by Mr Reid and to permit erection

upon it of a temporary laboratory and office building and a range of glasshouses. The ready agreement of the College authorities to these plans assured continuity of the strawberry work and provided the Institute with a permanent centre in the West of Scotland from which to work. These facilities at Auchincruive were completed in the winter 1953/54, and their provision must indeed be regarded as a milestone in the history of the Strawberry Disease Investigation and a recognition of its excellent work during the past 20 years.

During March, 1953, the Dundee staff of the Institute moved from Vernonholme to the offices and temporary laboratories prepared at Mylnefield. On March 25th the Memorandum and Articles of Association were received from the solicitors and the certificate of incorporation of The Scottish Horticultural Research Institute was duly signed, sealed, and delivered by the Registrar of Companies in Edinburgh on March 31st. On April 1st the Board of Management became the Governing Body of the newly incorporated Institute. April 1st, 1953, therefore marks the end of one chapter and the beginning of a new; the fulfilment of the hopes and aspirations of a considerable body of men, both in the horticultural industry and in government administration, who laid the foundations on which the Institute is now building.

Among all the bodies to whom acknowledgment is due, special mention must be made of the University of St. Andrews, and particularly of University College (now Queen's College), Dundee. The vital part played by the University in the affairs of the Scottish Raspberry Investigation has already been described. Its interest in horticultural research took a further concrete form in the recognition, during the year 1952-53, of the Scottish Horticultural Research Institute as a centre for post-graduate work. The Director, Dr. Cadman and Dr. Wood were appointed honorary lecturers in the University, enabling them to supervise post-graduate students working for higher degrees. This is a gratifying arrangement, providing as it does a further avenue of training for research workers in the sciences ancillary to horticulture.

This account of the Institute's history would be incomplete without an acknowledgment to its members of staff, both those "taken over" and those who have joined since 1951, for their assistance and co-operation. Grateful thanks are due to the Department of Agriculture for help and advice; and also to the members of the Board of Management, now the Governing Body, for their assistance and support, both in formal business meetings and, perhaps more especially, on the occasions of their visits to the farm and laboratories.

Administrative Report

The events leading up to the Institute's foundation in 1951 and to its legal establishment on 31st March, 1953, have already been described. This and the research reports which follow therefore cover the period April 1st, 1953 to March 31st, 1954, although necessary reference is made to certain work started in the two preceding years.

BUILDINGS

In March the staff moved from Vernonholme, Dundee, to the temporary laboratories and office buildings at Mylnefield. Considerable improvisation has been necessary throughout the year to provide accommodation for new members of staff, and all those parts of the farm buildings not absolutely essential for agricultural purposes have been pressed into use. This congestion will be relieved when the new laboratory and administrative block is completed.

Mr Reid and his staff had a comparatively smooth transition from their former quarters in the Horticultural Department, Auchincruive, to their new buildings which were completed in November, 1953. These comprise a well appointed laboratory and administrative building, three glasshouses with ancillary potting shed and store, and a range of cold frames.

At Mylnefield, a small propagating house and 100 feet of cold frames were added to the glasshouse block.

STAFF

Although it proved impossible to fill all the available new and vacant posts, the staff increment during the year was satisfactory. Dr Guttridge was appointed for work on strawberries and Mr M. M. Anderson and Mr W. Fordyce were appointed as assistants to Dr Wood. Miss K. S. Anderson joined the staff as assistant to Dr Cadman and subsequently spent three weeks at Rothamsted Experimental Station as a visiting worker in the Plant Pathology Department. With the appointments of Dr W. R. Jarvis to Mylnefield and Dr I. G. Montgomerie to the West of Scotland Unit for work on the host/parasite relationships of *Phytophthora fragariae* (red core root rot) we may anticipate developments in the technique of testing strawberry seedlings for resistance to this fungus.

Mr L. S. Gray came to us as Farm and Plantations Officer and now relieves the Director of much of the work connected with management of the farm. Mr R. W. Reid, transferred from the Scottish Raspberry Investigation to the Institute in 1951, became plantation foreman and in this capacity retains his connection with the fruit work.

Mr D. M. Leighton resigned in May to take up a post with an Angus firm of fruit growers and processors. For the previous eighteen months he had ably assisted with the vegetable work in addition to managing the production and disposal of the virus tested stocks of raspberries. He is succeeded by Mr L. H. Frith, formerly of the Welsh section of the National Agricultural Advisory Service. Mr R. J. Rose resigned on his appointment as head gardener to the Northern Horticultural Society at Harrogate.

Settling into a new site precipitates many new problems of organisation and administration and the ingenuity and patience of Mr Ross and his staff have been taxed to the full. Nevertheless, continuity of the work on raspberries and strawberries has been preserved and the research reports show that much has been achieved and new lines of work developed in what can justly be called a difficult year.

THE FARM

Mylnefield, 165 acres in extent, lies on the crest of one of the Old Red Sandstone outcrops on the north bank of the Tay. Much of the land faces south or south-west and is exposed to the westerly winds. The need for providing shelter for the new plantations of tree fruits was anticipated and windbreaks of mixed hardwoods and conifers were planted in 1953 and 1954, under Dr Wood's supervision, across the prevailing wind track. Experience indicates a necessity for further plantings of fast-growing trees to protect the plum trials and some of the raspberry plantations from serious damage.

The most important development during the year was the acquisition of Bullion farm, which is contiguous with part of the northern boundary of Mylnefield. Bullion comprises a farmhouse and steading with about 80 acres of land lying on both sides of the main Perth-Dundee highway. While it was hoped that the farm might ultimately be acquired, it was not expected to become available for a number of years. It was offered for sale in the spring of 1953 but negotiations for its purchase were not completed until February, 1954. The conditions of purchase allow the vendor a life interest in the farmhouse. Bullion now provides the Institute with a site for its vegetable work and about 40 acres were ploughed and sown with a cereal crop in preparation for use next season.

Mylnefield and Bullion together total about 250 acres, of which some 30 acres are now occupied by experimental crops of apples, plums, soft fruits and vegetables. The remainder is farmed on a five or six-course rotation with the object of cleaning and preparing the land for future experimentation. During the year a total of 75 bullocks were fattened entirely on the produce of the farm and yielded a valuable store of dung. The income from sales of livestock and produce, including sugar beet and potatoes, totalled £12,034 and the farm accounts balanced with a small surplus of income over expenditure.

The soft fruit crops were satisfactory, although the strawberry crop suffered much loss from grey mould *(Botrytis)* during the wet summer. Loss from this cause was much greater in Royal Sovereign than in Climax. Raspberries also suffered from moulding, especially the early varieties Malling Promise and Malling Exploit, but losses were minimised by frequent picking. Raspberry beetle *(Byturus tomentosus)* made its first appearance this season and measures for its control will be necessary in the future. Most of the raspberry crop was disposed of locally but a proportion was sold for export to the United States.

COLLABORATION

Although the West of Scotland Unit is an integral part of the Institute it is physically separated from Mylnefield by some 120 miles. Maintaining a sense of unity under these conditions is inevitably a difficult

task, but the nature of the recent developments at Auchincruive and the degree of working co-operation that has been achieved through the exchange of visits between staffs are gratifying proof that this difficulty can be surmounted.

It is a pleasure to record that the help and interest accorded by many different bodies to the Strawberry Disease Investigation and to the Scottish Raspberry Investigation have been extended to the Institute. With the Scottish Department of Agriculture we have co-operated in establishing regional fruit variety trials, Mylnefield being the main co-ordinating centre. This project is organised by a committee of the Scottish Agricultural Improvement Council on which the Director and Dr Wood have served. Informal contacts have been maintained with many members of the Department's Agricultural and Horticultural Inspectorates. The Institute has also provided material for and co-operated with the Department's marketing officers in their regional exhibitions of vegetable marketing and grading.

With East Malling Research Station co-operative work on the trial and maintenance of Mr N. H. Grubb's new raspberry seedlings has been continued. In addition to providing guidance on the design of the field experiments at Mylnefield the Station generously gave us some 600 trees for planting the first apple variety-rootstock trials.

During the summer Mr North negotiated with the Air Ministry the establishment of a meteorological station at Mylnefield. A suitable site was agreed and the necessary instruments bought and installed. Daily records were started on 1st January, 1954.

Messrs Smedley's Ltd., Dundee, Eastern Counties Preserves Ltd., Forfar, Messrs Chivers & Sons Ltd., Montrose, Messrs R. & W. Scott. Ltd., Carluke, and Mr R. McIvor conducted canning and jam-making tests of fruit and canning and quick-freezing tests of vegetables on our behalf, and useful contacts were made with the Fruit and Vegetable Preservation Research Station, Campden and the Ministry of Food Research Establishment, Aberdeen.

Grateful acknowledgment is also made to the Kellogg Foundation for the texture meter of American construction used in the work on peas; and we are indebted to many individuals and a number of British and Overseas firms for gifts of seeds and plant material.

LIBRARY AND PUBLICATIONS

Under the chairmanship of Dr Cadman, the library committee has supervised the purchase and cataloguing of books and journals of which the Institute now owns a useful collection. At a time when we had few publications to exchange we are grateful for so many gifts of reprints, reports and journals from institutes at home and overseas, and particularly to Dr F. R. Tubbs of East Malling for the gift of a set of his Station's Annual Reports and of Horticultural Abstracts; also to Professor T. Wallace for an equally valuable set of Long Ashton Annual Reports.

Publications from the Institute this year are listed in the departmental reports. Certain papers, including two by Dr Wood and Mrs Robertson, were published after 31st March, 1954, but are conveniently recorded in this report.

OTHER ACTIVITIES

The Institute had a number of visitors during and preceding the present year. We particularly welcomed Dr George M. Darrow of the United States Department of Agriculture, Beltsville, who also spent some days with Mr Reid; and Dr R. V. Harris of East Malling on his first return visit to Scotland since the Institute's inauguration. Mr N. H. Grubb's annual visits in connection with the raspberry work continue to be a stimulus to us all. An Open Day was held on July 18th when some 70 growers visited the Institute.

The Director visited plant breeding institutes and growers in Scandinavia during the summer. Mr R. D. Reid presented a paper to a meeting of the British Mycological Society in October and lectured at a "Growers' Conference" in Edinburgh in November. Dr Wood gave a talk on raspberries in the Home Service of the B.B.C. on October 18th and lectured to growers on raspberry culture in Edinburgh, Dundee, Longforgan and Carluke. Mr North gave a lecture in Aberdeen on vegetable breeding. In April Dr Cadman was elected to the Council of the Association of Applied Biologists.

Department of Plant Pathology

by C. H. Cadman

The removal of equipment and plant material from Vernonholme and West Park, Dundee, was completed and we occupied the new glasshouses and temporary laboratory at Mylnefield in April, 1953. Part of the glasshouse range is equipped with 400 W. h.p. mercury vapour lamps. Using this supplementary illumination during daylight hours we obtained excellent growth of plants throughout the winter months and were able to carry on a full programme of work.

RASPBERRY LEAF CURL

Close study of the spread of raspberry leaf curl disease in the field and continued failure to find either wild raspberries or brambles infected with this disease had convinced us that the virus or viruses responsible were spread to cultivated raspberries from a perennial weed host of some sort. Determined efforts were therefore made to find whether leaf curl could be mechanically transmitted from raspberries to other herbaceous hosts.

When infected raspberry leaves were ground with nicotine sulphate we found that the extract, after dialysis, contained viruses that produced ringspot symptoms on tobacco, cucumber, *Petunia* and other Solanaceous hosts. No symptoms were produced on these hosts by similarly treated extracts from apparently healthy raspberries known to be infected with certain aphid borne viruses. In February, some 400 small Norfolk Giant raspberry seedlings were inoculated with sap from a tobacco culture of leaf curl; six of the seedlings developed typical leaf curl symptoms three to four weeks later. This is the first time that any virus affecting raspberries has proved to be sap transmissible, and the event has made possible an entirely new approach to a long-standing problem.

These ringspot viruses are readily transmissible from infected tobacco and petunia to *Nicotiana rustica, N. glutinosa, Physalis* spp., *Tropaeolum* and tomato. They cause local lesions on French bean, *Datura stramonium* and *Hyoscyamus niger*, and virus can readily be transferred from these to *Petunia* seedlings. None of the local lesion isolates we have worked with protected against infection with tobacco ringspot, *Tropaeolum* ringspot or tomato blackring viruses.

The leaf curl ringspots also cause symptoms on common weeds, including chickweed, groundsel, *Plantago major* and *P. lanceolata*. Similar, though not identical, viruses have been found infecting sugar beet, groundsel, chickweed, coltsfoot, ragwort and thistles in the vicinity of leaf curl outbreaks, and attempts are being made to infect raspberries with these viruses. From these results it is presumed that weed hosts are the sources of leaf curl infections, but despite intensive search no insect vector has yet been found.

(C. H. Cadman, J. Chambers, A. G. Fisken.)

OTHER RASPBERRY VIRUSES

Studies on the susceptibility of raspberry varieties to infection with veinbanding virus showed that, respectively, 11, 11, 1, 0 and 3 out of 20 plants each of Lloyd George, Malling Jewel, Malling Promise, Malling Exploit and Norfolk Giant became infected after each plant had been colonised with 100 viruliferous *Amphorophora rubi*. These results confirm the surmise, from field observations, that Lloyd George and Malling Jewel are more susceptible to virus infection than the other three varieties listed. Nevertheless, spread of veinbanding virus in Lloyd George in the field is a slow process. A field experiment begun in 1951 showed that the virus spread to one or other of the adjacent healthy plants from only 10 out of 36 infected canes planted. A second trial planted in 1953 consisted of blocks of 48 healthy plants, each with a centrally placed infector, and was designed to give information on the rate of spread of veinbanding in Lloyd George in relation to control of aphid populations by spraying. The insecticides used were Systox, Parathion and DDT applied once (24th June) or twice (24th June and 29th July) during the season, these treatments being replicated 4 times and the unsprayed controls, 16 times. Aphid counts made before and after each spray application showed that Systox gave the most efficient control. Records of virus spread are not yet available.

(C. H. Cadman, A. G. Fisken.)

The results of work on the aphid vector relationships of leaf mottle virus were published during the current year.[1] Similar work on vein-banding and other raspberry viruses has temporarily been suspended, due to our pre-occupation with leaf curl and to the lack of a suitable technique for raising seedlings of black raspberry *(Rubus occidentalis)*, an essential test plant for this work. Experiments with seeds of red raspberry *(R. idaeus)* have shown that these will not germinate unless stored for 4-6 weeks at 25°C and subsequently held for 7-8 weeks at 0°C. The percentage germination is increased by soaking the freshly harvested seeds for 4 days in 1% calcium hypochlorite solution. The optimum combination of treatments, however, gave a maximum percentage germination of only 60-70. (C. H. Cadman, K. S. Anderson.)

PRODUCTION OF VIRUS FREE RASPBERRIES

Samples from the nuclear stocks of Malling Exploit, Lloyd George and Malling Landmark were graft tested and the results show that these stocks are still free from serious virus infection. Our stock of Norfolk Giant contracted leaf curl in 1952 and had to be abandoned. The stock of Malling Promise was found to contain plants producing small crumbly fruit and was withdrawn pending the development of a re-selected stock.

(C. H. Cadman, R. J. Rose.)

The production of healthy raspberry stocks has been revolutionised by the finding that virus infected plants can be cured by growing them for periods of 16-21 days at temperatures of 35-38°C. Details of the technique have been published.[2] Virus free plants of the varieties Norfolk Giant, Lloyd George, Malling Jewel and Burnetholm Seedling have been obtained and these are being propagated intensively. The latent virus present in Malling Promise has so far withstood 21 days at 35°C.

(J. Chambers.)

POTATO VIRUSES

By arrangement with the Department of Agriculture for Scotland and the Agricultural Research Council work was begun on the factors affecting spread of potato leaf roll and rugose mosaic in the seed potato growing areas of Scotland. Experiments in progress at Mylnefield are designed to give information on the time and rate of spread of these diseases in relation to dates of planting and roguing. Through the co-operation of Messrs T. Mabbot, Department of Agriculture for Scotland, M. W. Shaw, North of Scotland College of Agriculture and G. Stell, University of Glasgow, tuber samples were received from infected experimental and field crops in the northern, western and eastern areas. These are being grown on for observation. (C. H. Cadman, J. Chambers.)

Exploratory work was carried out during the summer on aphid-trapping and other experimental techniques. From November onwards a search was made for over-wintering hosts of the peach-potato aphid, *Myzus persicae*, in the East Lothian, Angus and East Perthshire areas. In East Lothian, populations were found until February on savoy cabbage, brussels sprouts, seed cabbage, spring cabbage and broccoli, and in isolated mangold clamps. The aphid was later found on protected

crops of lettuce, carrots, turnips, cauliflower and, eventually, on early potatoes. The late arrival of *M. persicae* on potato crops in Angus and East Perthshire may be due to the scarcity in these areas of such sites for over-wintering. **(A. G. Fisken.)**

Publications.

1 CADMAN, C. H. (1954). Studies in Rubus Virus diseases. VI. Aphid transmission of raspberry leaf mottle virus. *Ann. Appl. Biol.*, **41**, 207.

2 CHAMBERS, J. (1954). Heat Therapy of Virus Infected Raspberries. *Nature*, **173**, 595.

Department of Horticultural Botany

by C. A. Wood

For the period covered by the present report the Pomological and Vegetable Culture investigations at Mylnefield have been combined in a single department, that of Horticultural Botany. The pomology programme is in the main a continuation and expansion of work started under the aegis of the Scottish Raspberry Investigation. Work on problems of vegetable culture was begun in a small way in 1952, with trials and observational plots of canning peas, brussels sprouts, broccoli and winter cabbage, the trials of the three brassica crops being carried out in conjunction with the National Institute of Agricultural Botany. Vegetable investigations were much expanded in 1953, following the appointment in the previous autumn of Mr North.

Pomology and Fruit Culture

EXPERIMENTS ON THE CULTIVATION OF RASPBERRIES

Cultural practices in commercial raspberry growing vary considerably, often within a single district. Varieties of raspberry also differ in vigour, growth habit and reaction to cultural treatment. In the East of Scotland the varieties in widest use are Malling Promise, Lloyd George, Malling Jewel and Norfolk Giant, and all are grown on the "stool" system, in which the rows are kept as clear as possible of spawn canes ("suckers") and only canes arising from the original stools are retained for fruiting. Training is almost invariably done on the post-and-wire system, of which there are, however, two forms, and tied-in canes are normally "tipped" during the winter at heights determined by varietal vigour and the preference of the grower. By contrast, the only variety grown extensively in the West of Scotland is Burnetholm Seedling, a raspberry of local origin. There again the plants are usually restricted to stools, but most growers, especially on the slopes of the Clyde Valley, adopt variations of the training system in which the canes of one stool are bunched together, bent over, and tied to those of the next, without the use of posts or wire.

The influence of cultural practices on plantation performance is now being studied at Mylnefield in a series of statistically designed field experiments begun in 1951 and 1952. These contain several contrasting

varieties, of which the chief are Malling Promise, Lloyd George and Norfolk Giant. In one experiment, on distances of planting and heights of tipping, inter-row distances of 5½, 7 and 8½ feet and inter-plant spacings of 2, 2½ and 3 feet are being compared, and a comparison of three heights of tipping was added at the end of the second year. So far, irrespective of variety, the widest planting distance (8½ x 3 feet) has given the highest fruit yield per stool, but the closest distance (5½ x 2 feet) the highest yield per acre. The distances of planting have clearly affected the production of stool canes of suitable quality for fruiting, but it is uncertain yet whether the fruiting performance of individual canes is being affected. In 1953 a significant increase in yield was obtained from plots of all varieties where the canes had been tipped at 4½ feet as compared with those tipped at 4 feet, and tipping at 5 feet gave a further (though non-significant) yield increase in Norfolk Giant and Malling Promise.

In a second experiment, containing the above three varieties and Malling Jewel, comparison is being made between planting a single cane at a site ("single" planting) and planting two together ("double" planting). By 1953, the second summer of growth, all four varieties had yielded more heavily from double planting, the increase in the case of Malling Jewel amounting to about 80%. A third experiment has shown that increasing the frequency of picking can increase the total yield per acre, a result which agrees with the experience of some who grow raspberries for the canning trade or for fresh consumption. The same experiment is concerned with the effect of varying the number of canes retained on each stool for fruiting.

This series of experiments will take several years to complete, and in many cases the conclusions will require examination from an economic angle. By the end of 1953, however, the results on distances of planting were felt to justify a further experiment employing a standard row-width of 6 feet, with varied planting distances between the canes and with some rows "stooled" and others allowed to form canes continuously. This was planted in March, 1954, together with an experiment comparing the traditional post-and-wire training system of the East of Scotland with methods used in the Clyde Valley and New Zealand. The need has now arisen for more detailed investigations, particularly of the effect of shade on bud development in closely planted rows and of the reason for the increased yield from frequent picking. The construction of a large fruit cage to accommodate such work was begun in the winter 1953/54, and this should be available for use by autumn 1954.

(C. A. Wood and H. M. Robertson.)

RASPBERRY BREEDING

In continuation of co-operative work with Mr N. H. Grubb, of East Malling Research Station, records have been taken each year from the performance trial of Malling Promise, Lloyd George (New Zealand stock) and five unnamed Malling selections, which was planted at Kirriemuir in 1949. The results of this and other selection work have been published.[1] The trial demonstrated the high cropping capacity in Scotland of the New Zealand stock of Lloyd George and gave further information on the comparative merits of Malling Promise and its sister-variety Malling Exploit (formerly Seedling 'X,' 51/84). In 1951 a further

trial was planted at Mylnefield to compare six Malling seedlings of more recent origin and six named varieties (Lloyd George, Norfolk Giant and the Malling varieties Promise, Exploit, Enterprise and Jewel). This has since provided useful data on the cropping, canning qualities and seasons of ripening of the seedlings. Virus-tested stocks of eleven Malling seedlings, including the six in this trial, are now being propagated at Mylnefield to supply material for trials at official centres elsewhere in the United Kingdom.

During 1952 and 1953 a raspberry breeding programme was started at Mylnefield, in association with the similar work at the Institute's unit at Auchincruive. Ten crosses were made between varieties and seedlings of the red raspberry *(Rubus idaeus* or *R. strigosus),* and some 3,000 seedlings have since been planted out. The chief objective is to combine high yielding capacity with improved fruit quality, particularly in texture and flavour, and the special requirements of the canning and quick-freeze industries are being kept in mind. It is proposed to extend the programme to include a certain amount of inter-species hybridization, and for this purpose a start was made in 1953 to form a collection of *Rubus* species. We are indebted to Mr E. E. Kemp, curator of the Royal Botanic Gardens, Edinburgh, for much assistance in this connection.

(C. A. Wood, H. M. Robertson and M. M. Anderson.)

STRAWBERRY INVESTIGATIONS

The main strawberry investigations in progress prior to and during 1953 were concerned with (a) the seasonal cycle of flower and stolon production in ordinary spring-flowering strawberry varieties and certain "perpetuals," (b) the incidence and symptomatology of "June Yellows" in Auchincruive Climax and the effect of this breakdown upon yield, and (c) the field performance of several different stocks and selections of Climax and Royal Sovereign.

The work on the initiation and development of flowers and stolons, carried out by Mrs Robertson, was largely completed by autumn 1953. Two papers [2, 3] were published on the work with Royal Sovereign, Climax and Sir Joseph Paxton, and another,[4] dealing with flower production in "perpetual" varieties, is in the Press. These investigations showed that varieties differ in their seasonal development and that the cycle of flower initiation and development in Climax under Scottish conditions is intermediate between that of spring-flowering varieties and "perpetuals." It seems possible that Climax may be less subject than some other varieties to the influence of day length. With the appointment of Dr Guttridge it is hoped to use these results as a starting point for detailed physiological investigations into the influence of environmental factors on the growth and development of the strawberry plant.

Although much work has been done on the problem of June Yellows in Climax, it has so far yielded little new information. It appears, at least with some stocks, that an inspection of the mother plants in one year can provide no reliable basis from which to predict the incidence of yellows in the runners in the following year. There is, in fact, evidence that mother plants which are apparently quite green and vigorous may produce runners that develop symptoms of the severe yellows ("streak") type in their first season. It has also proved impossible to predict the rate at which a plant showing yellows in a fruiting plantation will decline in vigour to the point where it becomes useless.

In the summer of 1952 twenty-five plants of Climax showing yellows (including some with "streak") were stolon-grafted under glass to an equal number of plants from the greenest stock then available, and in the following spring the experiment was planted into open ground for observation. Symptoms of yellows appeared in a random manner in the indicators and controls in 1953, providing no evidence that the condition had been transmitted by grafting.

There still remains a limited hope that stocks of Climax substantially free from yellows will be obtainable by selection and roguing, although with certain clones now in commerce such an upgrading would seem quite out of the question. Work is continuing along any lines that appear to offer a prospect of improvement.

(H. M. Robertson, C. G. Guttridge and C. A. Wood.)

APPLE AND PLUM VARIETY-ROOTSTOCK TRIALS

Despite their small commercial importance in Scottish fruit growing it was felt that some work should be undertaken with apples, especially as Mylnefield is situated in the traditional apple and pear growing area of the Carse of Gowrie. In consultation with East Malling Research Station a group of statistically designed rootstock trials was planned in 1951 and planted in March 1954, using trees raised at East Malling. The rootstocks included are Crab C, Malling XXV, six from the older Malling series (M.I, II, IV, VII, IX and XVI) and four from the new Malling-Merton series (M.M.104, 106, 109 and 111). The scion varieties are Bramley's Seedling, King Edward VII, Grenadier and Royal Jubilee (culinary) and Beauty of Bath, Cox's Orange Pippin, Lord Lambourne, Laxton's Epicure, Laxton's Fortune, Laxton's Superb, Merton Worcester, Miller's Seedling, Red Melba, Tydeman's Early Worcester, Wagener, Winston and Worcester Pearmain (dessert). These varieties (not all of which are included in any one trial) were chosen as representative of particular periods of flowering and ripening, with the object of assessing their value as standards of comparison for future trials. One trial in this series is concerned with the culture of dwarf or semi-dwarf trees, suitable for the gardener or small-scale grower in favoured localities.

Climatic conditions in Scotland are generally considered more favourable for plum than for apple production. A plum variety 'elimination' trial, combined with a comparison of rootstocks, has therefore been established at Mylnefield in order to discover which varieties can be successfully grown and what are likely to be the main problems in plum culture in this part of Scotland. Trees of some 50 varieties, including most of the more recent British introductions and several from overseas, were planted in spring 1953, using, where possible, two trees of each variety on each of the rootstocks Myrobolan B, Common Plum and Brompton. This trial, which is observational and not statistically designed, has been sited so that further varieties can be added if desirable. It is not proposed to maintain it for more than about 10-12 years, since by that time the information sought should have become available.

(C. A. Wood, M. M. Anderson and W. Fordyce.)

SCOTTISH FRUIT VARIETY TRIALS

In 1952 a programme of regional fruit variety trials was inaugurated in Scotland by the Scottish Fruit Trials Committee, a committee of the Scottish Agricultural Improvement Council. There are four trial

centres, one at each of the three Agricultural Colleges (Edinburgh, Aberdeen and Auchincruive) and one at Mylnefield, the latter serving as the main co-ordinating centre.

Identical trials in progress at each of the centres at present consist of about ¾ ac. of raspberries (6 varieties), ½ ac. of black currants (16 varieties), ¼ ac. of strawberries (2 varieties) and a trial of some 36 varieties of plum. In addition, Mylnefield accommodates an apple variety collection of some 370 varieties, planted at 12 ft. x 8 ft. on M.IX rootstock and grown as dwarf bushes. This collection contains several old Scottish apples and many of English and continental origin. Apart from their general interest, it is hoped that some of these may prove of value in any future breeding programme. Also planted at Mylnefield is a variety "elimination" trial of some 85 modern apple varieties and unnamed seedlings, grown as open-centre bushes on M.I, M.II, M.IV and M.VII. This and the variety collection, and a smaller collection of pears, are being expanded as occasion arises.

MISCELLANEOUS

An investigation by the writer and Mrs Robertson into the growth, flowering and yield of raspberry fruiting laterals was continued in 1953, and Mrs Robertson began a study of flower initiation and development in blackberries, loganberries and hybrid raspberries *(Rubus idaeus* x *R. occidentalis)*. Mr Anderson began to assemble a collection of red currant varieties for future cropping trials and the study of varietal characters and synonymy.

Co-operation continued with Plant Pathology in connection with the propagation of raspberry nuclear stocks.

Vegetable Culture

VARIETY AND STRAIN TRIALS

These trials are primarily intended to assess the suitability of existing varieties of vegetables of British and foreign origin for use under Scottish conditions, and to provide material for a future breeding programme. The trials in 1953 were concerned mainly with brussels sprouts, winter-heading cabbage, summer spinach, dwarf beans and canning peas; small-scale trials of beetroot, bush tomatoes and winter lettuce were also conducted. In all these crops most of the varieties were eliminated as of little or no commercial value under Scottish conditions, only a few in each crop proving of sufficient merit to warrant further trial.

The influence of local climatic conditions on the growth and development of many of the varieties was found to be quite pronounced. The most notable effects were the tendency of some to "run to seed" prematurely and the failures in cabbage to produce firm heads. Another observed effect was the short-jointed growth of some varieties of brussels sprout regarded as tall and vigorous in England, although a few varieties were found to be appreciably uninfluenced by the local conditions and to grow as tall at Mylnefield as elsewhere. **(C. North, L. H. Frith.)**

VEGETABLE BREEDING

The previous year's trials had shown that none of the well-established varieties of certain vegetables were entirely satisfactory under

our conditions, and that breeding would be desirable; this was particularly true of the winter-hardy cabbages of the Christmas Drumhead and January King types and of brussels sprouts. Preliminary hybridization was begun in the spring of 1953, and during the following winter selections were made of parent material for the 1954 breeding programme. The objectives in brussels sprouts are increased hardiness, earlier maturity, a deeper green colour, and greater resistance to blowing over by wind. In winter-heading cabbages, breeding will aim at the production of strains of a more reliable heading performance and which can be cut later in the field—i.e., in the period January-March.

(C. North.)

PHYSIOLOGICAL INVESTIGATIONS

In support of the applied work outlined above an intensive investigation was started into the factors which determine the heading of cabbage. This work involves a study of the influence of factors such as temperature, light intensity and day length, using the "growth analysis" method. Encouraging progress was made but no definite information is yet available. It is expected that the results of this and similar studies will eventually enable the breeder to attain his objectives more quickly and more precisely, and will assist in determining the "correct" time to harvest yield trials of certain kinds of vegetables.

(C. North.)

Publications

1 GRUBB, N. H. and WOOD, C. A. (1954). Progress in Raspberry Breeding. *Rep. E. Malling Res. Sta. for 1953*, 95.

2 ROBERTSON, M. and WOOD, C. A. (1954). Studies in the development of the Strawberry. I. Flower-bud initiation and development in early- and late-formed runners in 1951 and 1952. *J. hort. Sci.*, **29**, 104

3 ROBERTSON, M. and WOOD, C. A. (1954). Studies in the development of the Strawberry. II. Stolon production by first year plants in 1952. *J. hort. Sci.*, **29**, 231-34.

4 ROBERTSON, M. Studies in the development of the Strawberry. III. Flower-bud initiation and development in large-fruited perpetual ("remontant") strawberries. *J. hort. Sci.* (In the Press).

West of Scotland Unit (Auchincruive)

by R. D. Reid

The move to the new premises built for the use of this unit took place during 1953/54, actual occupation of the glasshouses being obtained in early October and of the laboratory and office buildings at the end of December. The benefits from the extra facilities were therefore only available for part of the year, but it was possible to operate improved methods of working and to carry out pilot trials of new methods of testing which will facilitate the future work of the unit.

TECHNIQUES

In pursuance of the primary objective, which is the production of new strawberry varieties combining high commercial qualities with resistance to red core root rot, some innovations were made. The most important of these was the use of bench testing as a supplement to field testing for eliminating seedlings susceptible to Red Core. Hitherto the only practicable method of testing has been the growing of seedlings in infected soil under field conditions. A new glasshouse is fitted with trough-shaped concrete benches in which drainage and other environmental conditions can be controlled, and in these it is possible (a) to plant out seedlings at a much younger stage than in the field, (b) to plant these more closely together, (c) to determine the onset of root infection more rapidly, and (d) to use more uniformly infected soil than in the field. In preliminary trials with this technique 2,000 seedlings were tested in one bench with a gain of 12 months in time and a saving of half an acre of land for that period. In a corresponding field test with 5,000 older seedlings the infection rate was found to be higher, but the experience gained in the manipulation of environment in the bench test should avoid this discrepancy in future.

The improved facilities permit a better arrangement of seed sowing and the handling of seedlings, so that germination may be planned to fit in with the general routine of testing and development.

The "breakdown" of varieties highly resistant to red core has been shown to be due to the development of biologic races of the pathogen, and the practice of testing selections and named varieties by natural inoculum obtained from known sources has been continued, in pots in the glasshouse. During the past year, selections, varieties and species were indexed in this manner to five races of the pathogen.

(A. M. Sutherland, K. McConnell and R. D. Reid.)

SELECTION OF SEEDLINGS

The breeding programmes have hitherto been mainly confined in their objective to the production of varieties likely to be worthy of introduction. During the past year additional crosses and "selfs" were made, using *Fragaria* species and sub-species, in order to obtain information on sources of red core resistance and to provide long-term breeding material. This work was based on observations of differences in resistance exhibited by *F. virginiana* and *F. chiloensis* obtained from different sources.

In the production of varieties suitable for commercial introduction, a realistic view has been taken of the fact that no absolute or permanent immunity to red core is likely to be obtained, although, in practice, a very high degree of field control is possible by the use of highly resistant varieties. The discarding of seedlings simply because they proved susceptible to some races of the pathogen has now been discontinued, this change of practice being based on the observation that even when

plants become infected the degree to which growth and cropping performance is affected can only be determined by actual field test. Behaviour seems to be associated with several factors, including (a) limitation of the distance to which the pathogen is able to penetrate into and subsequently invade the root tissue, and (b) the capacity of the plant to rejuvenate its root system and undergo rapid recovery. Large numbers of recent seedlings have therefore been selected for further test, including those which remained completely free from infection and others which, though lightly infected, were not depressed in growth or vigour.

From the survivors of the 1945/46 crosses, three seedlings have been under intensive observation and are being prepared for early release. One should be available for release in the spring of 1955. Records have shown it to be as heavy a cropper as Climax and satisfactory reports as to its jam-making and canning properties have been obtained from commercial firms. Other selections from crosses made from 1945 onwards were retained for more intensive trials. Routine graft testing of seedlings under trial was continued, and virus tested plants of selections likely to be of use in future breeding work were transferred to the stock reserve in the gauze house.

In order to utilise the facilities of the Institute to full advantage the work of testing new varieties is now being shared by Mylnefield. Stocks of plants in two categories have been sent there: (a) selections for inclusion in fruiting trials; and (b) virus tested nuclei of three varieties considered suitable for development to the distribution stage.

(R. D. Reid and A. M. Sutherland.)

RED CORE DISEASE

A collection of isolates of *Phytophthora fragariae* Hickman was obtained to provide a basis for the identification of biotypes and their subsequent use in determining sources of resistance for the breeding programme. Thirty-one isolates are now available for this work, and we are indebted to Dr C. J. Hickman for pure cultures of twelve of these from his collection. Three biotypes have so far been identified out of ten isolates by means of differential varietal reactions and work is being continued with the remaining twenty-one isolates.

Using a biotype isolated from Huxley, a number of seedlings resulting from the "selfing" of varieties or species of *Fragaria* have been tested for resistance. The method of inoculation (dipping the roots of seedlings at the 3-4 leaf stage in a zoospore suspension of the fungus, and subsequently planting into sterilized sand) produced symptoms of infection in susceptible seedlings six days after inoculation. The testing of these families of seedlings is still in progress.

Tests were made of a considerable number of recipes for the preparation of bean and oat agar, and a medium consisting of oat agar was found which gave very satisfactory results with *P. fragariae*. The diameter of colonies after 10 days at 20°C on this medium was 76 mm. The effect of such factors as light, temperature, aeration and substrate on sporangial production *in vitro* was studied, but clear results were not obtained owing to the large variation within treatments in the number of sporangia produced.

(I. G. Montgomerie.)

Other Strawberry Work

The very serious degeneration occurring in some stocks of Climax, which, starting as "transient yellows," may progress through a varied range of symptoms to acute "streak," has been alarming. The subject is now under investigation at several centres, including Mylnefield. At Auchincruive our work has included studies of case histories of plants over extended periods, and has shown that the expression of symptoms is to a large extent conditioned by temperature during critical growing periods. A series of current experiments is concerned with the reactions of plants of a uniformly affected clone exposed to a range of environmental conditions. **(A. M. Sutherland, K. McConnell and R. D. Reid.)**

Some experiments are in progress to determine whether the occasionally occurring problem of intermittent cropping is related to a nutritional excess of nitrogen. **(A. M. Sutherland and R. D. Reid.)**

Raspberry Breeding

The minor industry of raspberry growing in the West of Scotland has been based mainly upon supplying the fresh fruit markets. Growers in that area consider that none of the recent introductions fill the need for a vigorous, heavy cropping variety producing fruit with the excellent marketing and processing qualities of the locally grown Burnetholm Seedling, but the latter, unfortunately, does not carry the weight of crop necessary under present economic conditions. Breeding with the object of producing a suitable variety of this type has been under way for some years and one promising selection from the 1946 crossings has been propagated. Large numbers of seedlings from 1951 and 1952 crossings were planted in the field in 1953 and further crosses made.

(R. D. Reid and A. M. Sutherland.)

In conclusion, it should be stated that, although separated by nearly 120 miles from Mylnefield, the West of Scotland unit is an integral part of the Institute and enjoys full and close co-operation with the staff of the mother station. Furthermore it is a source of great satisfaction to know that our close collaboration with the West of Scotland Agricultural College, whose hospitality we have so long enjoyed, will continue unbroken. The wider field of opportunity and better facilities now at our disposal in no way lessens our indebtedness to, and admiration for, our original joint sponsors, the Plant Pathology Section of the Department of Agriculture for Scotland and the West of Scotland College of Agriculture.

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